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# Phonetic cues and phonological constraints in prosodic unit definition: evidence for the intermediate phrase in French

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The studies referring to prosodic constituency in French generally agree on two levels of phrasing -the IP (Intonation Phrase) and the AP (Accentual Phrase) in (Jun & Fougeron 1995, 2000)- while the existence of an intermediate level of phrasing (ip) between these two units seems restricted to specific intonation structures observed in marked syntactic constructions (Jun & Fougeron 2002). The two experiments reported here provide evidence for the existence of an ip which is not restricted to marked syntactic structures but which can appear within all focus utterances if both syntactic structure and prosodic constraints allow it. The analysis here is grounded in the framework of Generalized Alignment Theory (Prince & Smolensky 1993). The analysis includes two important constraints, which reflect the prosody-syntax interface: 1) ALIGN XP,R,ip,R: align the right edge of a maximal projection with the right edge of an ip (Prieto 2005); and 2) a prosodic constraint stating that non-final intermediates phrases consist of minimally two APs. We specifically predict that the interaction between these two constraints conspires to place an ip-right boundary made of minimally two APs in correspondence with a major syntactic break such as the boundary between a Subject NP and a VP.

In a first experiment, we focus on phonetic properties (duration and F0 values) of syllables occurring 1) within a prosodic word, 2) at an AP-boundary which is not aligned with the right edge of a syntactic XP (AP), 3) at an AP-boundary which is aligned with the right edge of a syntactic XP (AP/XP) and 4) at an IP-boundary. The corpus was read at two speech rates (normal/fast). The results of a mixed model show that the right edge of an AP/XP boundary appears to be marked by a significant syllable lengthening (Fig. 1) at normal speech rate (Fig. 2;  $t=2.83$ ,  $p<0.05$ ) whereas F0 values of AP/XP syllables are not significantly higher than AP final syllables (Fig. 3;  $t=0.85$ ,  $p>0.05$ ). While the alignment between syntactic and prosodic structure seems to reinforce preboundary lengthening, the ALIGN-XP,R constraint is not sufficient to account for the emergence of an the boundary itself, since the subject NP is always produced as a single Accentual Phrase..

In a second experiment, we investigated the duration and F0 values of all focus SVO utterances in which the structure of the subject NP was varied in order to obtain either a sequence of 2 or of 3 AP as exemplified in (Fig. 4). The corpus was read at two speech rates (normal/fast). We measured duration and F0 values of V2 (the AP 2 final vowel) in both 2APs and 3APs conditions. F0 values were included as ratios of the relevant H target divided by the F0 height of the first H in the utterance (D'Imperio and Michelas, 2009). This was done in order to normalize for pitch range variation across repetitions. Note also that V2 is associated with an ip-boundary in the 2 APs condition while it is only associated with an AP-boundary in the 3APs condition. We also measured the height of the first LH\* within the following ip (Hpb in Fig 4). Note that for both normal and fast speech rates, V2 is significantly longer in the 2APs condition than in the 3APs condition (normal speech rate  $t=-8.487$ ,  $p<0.05$ ; fast speech rate  $t=-3.250$ ,  $p<0.05$ ) and that H2 is significantly higher in the 2APs than in the 3APs condition (Fig. 5; normal speech rate:  $t=-3.67$ ,  $p<0.05$ ; fast speech rate:  $t=-9.43$ ,  $p<0.05$ ). We also found total pitch reset occurring before the ip-boundary, while we only found partial reset at the first LH\* peak following the intermediate phrase boundary (Hpb; Fig. 6) as already

observed for Germanic languages (Ladd, 1988; Van den Berg et al. 1992; Truckenbrodt, 2002).

Hence, we propose that the intermediate phrase is signaled in French by (i) preboundary lengthening (ii) the presence of H- phrase accent which is responsible for blocking recursive downstep of subsequent AP final rises within the ip and (iii) partial reset across the ip boundary. The analyses show that both local phonetic cues and phonological constraints have great importance in the ip definition for French. An interesting interplay of duration and pitch height is responsible for signaling the boundary and will be investigated through perceptual experiments.

	Target vowel /a/
1- within a Prosodic Word	Les gre <sup>na</sup> diers/AP de marrakesh]ip ne poussent pas bien vers chez nous. <sup>JIP</sup>
2- at an AP boundary	Le sauna/AP de Paolo]ip deviendra incontournable. <sup>JIP</sup>
3- at an ip boundary	Le sauna]ip deviendra incontournable. <sup>JIP</sup>
4- at an IP boundary	Le sauna]IP d'après ce qu'on m'a dit]IP n'est pas très loin. <sup>JIP</sup>

Fig. 1 : Target syllables in Experiment 1

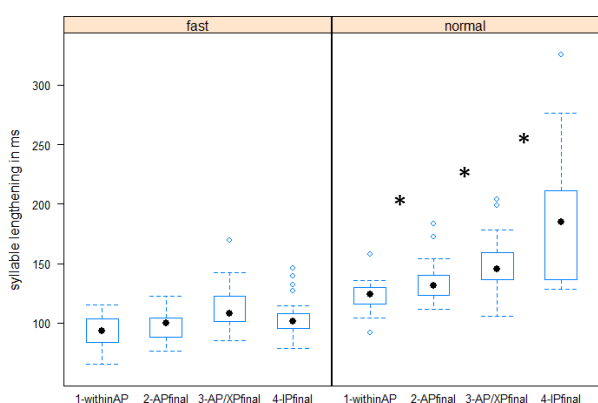


Fig. 2 : Syllable lengthening in ms across boundary type for both speech rates for Experiment 1.

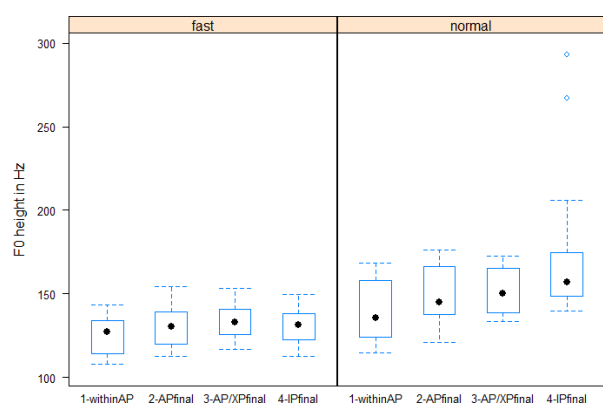


Fig. 3 : F0 height across boundary type for both speech rates for Experiment 1.

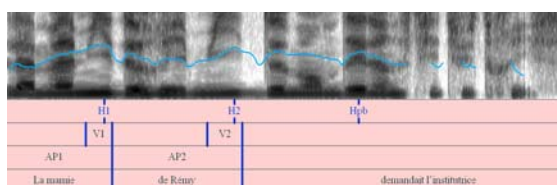


Fig. 4a: F0 curve for the sentence *La mamie de Rémy demandait l'institutrice* ("Remy's grandmother asked for the teacher") where the subject NP is made of 2 APs.

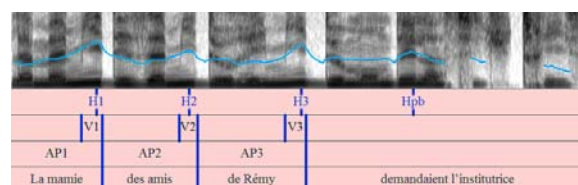


Fig. 4a: F0 curve for the sentence *La mamie des amis de Rémy demandait l'institutrice* ("The grandmother of Remy's friend asked for the musician") where the subject NP is made of 3 APs.

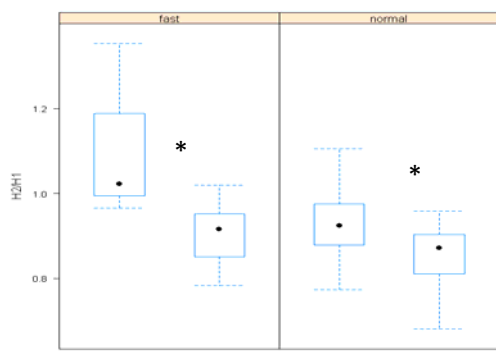


Fig. 5: F0 height ratio between H2 and H1 in 2 AP and 3 AP utterances at fast and normal speech rates.

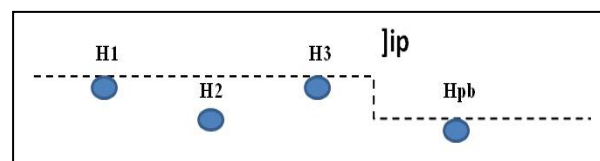


Fig. 6: Schema of total pitch reset before an ip-boundary and partial pitch reset after an ip-boundary in utterances where the subject NP was made of 3 APS (from D'Imperio and Michelas, 2009).

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